J. Phytol. Res. 10 (1-2): 141-144, 1997

ANTIFUNGAL AND ANTIBACTERIAL ACTIVITY OF SILICON AND TIN COMPOUNDS

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Biochemical aspects of some organosilicon and organotin complexes of Salicylanilide (Sal. Anil) and its thiosemicarbazone (Sal. Anil. TSCZ) have been described. In order to assess their growth inhibitory potency, the ligand and their organo complexes have been tested *in vitro* against a number of pathogenic fungi : *Alternaria brassicicola, Macrophomina phaseolina, Fusarium oxysporum* and bacteria : *Xanthomonas campestris, Pseudomonas pisi, Escherichia coli* and *Staphylococcus aureus* at different concentrations and were found to possess remarkable fugicidal and bactericidal properties. Tin compounds showed better activity than Silicon complexes.

Keywords: Bactericides; Fungicides; Organo Compounds.

Introduction

During the last few years, several references are available on organometallics for their antifungal anticarcinogenic[1] and tuberculostatic[2] activities. Mehrotra *et al.*[3] reported the preparation and characterisation of organosilicon complexes. Fungi and bacteria are the causing agent of many diseases of plant & Animals. Man is directly dependent upon plants for his survival because plants are his prime source of food, fibre, drugs and they utilize Co_2 in photosynthesis and release O_2. Pathogens damage the plants eg. leat spot of mustard caused by *Alterneria brassicicola, Fusarium oxysporum* causes wilting disease on pea and *Macrophomina phaseolina* causes root rot of gram. Like fungi, bacteria : *Xanthomonas campestries* causes black - rot of crucifers and *Pseudomonas pisi* causes bacterial blight of pea. However, effective control measures for these diseases are lacking. Present investigation were undertaken to evaluate antifungal & antibacterial activity of silicon & tin compounds.

Materials and Meth

(a) *Synthesis of New Compounds* : During the present studies certain starting materials and organometalics were used as received from fluca. However, the complexes of organotin and organosilicon were prepared by refluxing Ph_3SnCl and Ph_3SiCl with sodium salt of Salicylanilide (Sal. Anil.) and Salicylanilidethiosemicarbazone (Sal. Anil. TSCZ) have been carried out in 1:1 molar ratio. These compounds were characterised by usual chemical techniques (Fig I-VI).

Ph_3SnCl + Sal. ONa $\xrightarrow{MeOH}$ Ph_3Sn (O Sal.) + NaCl

Ph_3SiCl + Sal. ONa $\xrightarrow{MeOH}$ Ph_3Si (O Sal.) + NaCl

Ph_3SiCl + NaO Sal. TSCZH $\xrightarrow{MeOH}$ Ph_3Sn (O Sal. TSCZH) + NaCl

Ph_3SiCl + NaO Sal. TSCZH $\xrightarrow{MeOH}$ Ph_3Si (O Sal. TSCZH) + NaCl

(b) *Isolation of Pathogens* : Fungi were isolated from plants. *F. oxysporum* from pea, *A. brassicicola* from mustard and *M. phaseolina* from Gram. They were purified and maintained on PDA medium. Bacterial cultures obtained in pure form from IARI, New Delhi. Compounds were tested *in vitro* using poisoned food technique for fungi[5] and inhibition zone technique for bacteria.[6]

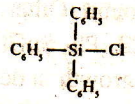
(i) *Poisoned Food Technique* : PDA medium

Table 1. Antifungal activity of silicon and tin compounds.

	Percentage inhibition after 96 hours at 25 ± 2°C											
	Alternaira brassicicola				*Fusarium oxysporum*				*Macrophomina phaseolina*			
Compounds	25	50	100	200	25	50	100	200	25	50	100	200
Ph_3Sn (Sal. Anil. TSCZ)	81.5	100	100	100	50.78	66.4	78.9	87.5	36.6	57.6	60	75
Ph_3Si (Sal. Anil. TSCZ)	78.9	86.6	100	100	60	69.2	75	78.9	36.6	50	60	64
Sal. Anil. TSCZ	76.92	80.5	81.12	86.66	47.65	53.12	56.25	59.32	33.0	40.5	44.9	61.5
Ph_3SnCl	61.5	69.5	85.07	86.66	41	48	53.12	61	32	39.06	46.6	57.03
Sal. Anil.	56.6	63	75	83.07	39.06	43	52	60	26	36	44	56
Ph_3SiCl	54	61	67	78.9	33	39	47	58	25	28	32	43
Bavistin	82.35	90.63	100	100	83.3	86.9	100	100	81.07	84.4	100	100

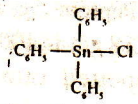
Table 2. Antibacterial activity of silicon and tin compounds.

	Diameter of inhibition zone (mm) after 24 hours at 25 ± 2°C											
	Xanthomonas campestries (-)			*Pseudomonas pisi (-)*			*Escherichia coli (-)*			*Staphylococcus aureus (+)*		
Compounds	500	1000	2000	500	1000	2000	500	1000	2000	500	1000	2000
Ph_3Sn (Sal. Anil. TSCZ)	9	11	18	8.5	12	19	11.5	13.5	24.0	13	15.5	25.0
Sal. Anil.	8	10	17	11	13	15.5	12	15	17	12	14.5	21.0
Sal. Anil. TSCZ	6.3	8.0	10	6.5	8	12	8	10	15	11	12	14.5
Ph_3Si (Sal. Anil. TSCZ)	5	6	9	3	4	6	5	6	9	7	8	13
Ph_3SnCl	2	5	7	2	3	5	3	4	7	4	7	9
Ph_3SiCl	2	3	4	2	5	7	2	4	6	3	5	8
Streptomycin	6	8	10	7	8	11.5	15	18.3	22	18.6	21.5	28.0



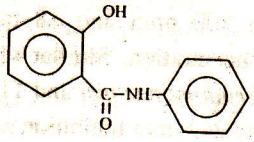
Triphenyl Silicon Chloride
(Ph_3SiCl)

Fig. I



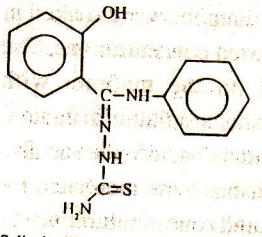
Triphenyl Tin Chloride
(Ph_3SnCl)

Fig. II



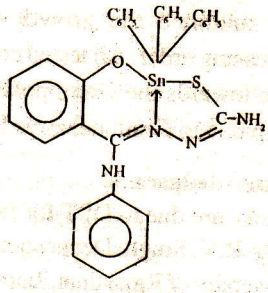
Salicylanilide
(Sal. Anil.)

Fig. III



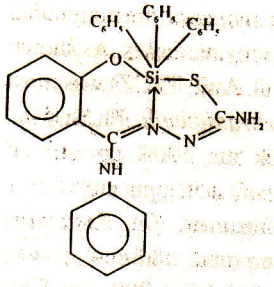
Salicylanilide thiosemicarbazone
(Sal. Anil. TSCZ)

Fig. IV



Triphenyl Tin (Salicylanilide thiosemicarbazone)
[Ph_3Sn (Sal. Anil. TSCZ)]

Fig. V



Triphenyl Silicon (Salicylanilide thiosemicarbazone)
[Ph_3Si(Sal. Anil. TSCZ)]

Fig. VI

(Dextrose 20 g, Agar Agar 20g, Starch 20 g and 1000 ml distilled water) was prepared in one litre flask and was autoclaved at 15 lb/in^2 pressure for 30 minutes. Accurate amount of all the compounds were amended after being dissolved in methanol, so as to get certain final concentrations of 25, 50, 100 and 200 ppm. Aliquots of 15 ml medium was poured in 90 mm sterlized petiplate in replicates. The plates were inoculated with an agar block (5 mm diam) cut from leading edge of a colony of the test pathogen. Control set without compounds was also maintained and Bavistin used as a standard fungicide. Plates were incubated for 4 days at 25 ± 2°C and colony diameter was measured after the incubation period. The percent inhibition of growth was calculated using the following formula and the results are presented in Table 1.

% Growth inhibition = C-T/C x 100

Where, C = Growth in Control

T = Growth in Treatment

(ii) *Inhibition Zone Technique*: Flat bottomed, 90 mm petridishes were used. Nearly 15 ml of

the Beef extract medium (Peptone 5g, Beef extract 5g, Agar-Agar, NaCl 8 gm in 1000 ml distilled water) was pipetted into the petridishes. Bacterial suspension was added in the medium. Tested compounds were dissolved in methanol in 500, 1000 and 2000 ppm concentrations. Whatman filter paper no. 1 discs of 5 mm diameter were soaked in these solutions of varied concentrations. The discs were placed on the medium with organisms in petridishes at suitable distances. Streptomycin as standard bactericide was also tested. These petridishes were incubated for 24 hours at 25 ± 2°C and zone of inhibiton was measured in mm. The results are presented in Table 2.

Results and Discussion

As the concentration increases, the fungicidal and bactericidal activity increases. As shown in table 1, Ph_3 Sn (Sal. Anil. TSCZ) was most active on *Alternaria brassicicola*. Ph_3 Sn (Sal. Anil. TSCZ) check the 100% growth of *Alternaria brassicicola* at 50 ppm and 81.5 % at 25 ppm concentration. On *Fusarium oxysporum* this compound inhibited growth 50.75% at 25 ppm of 87.5% at 200 ppm. This compound is less active on *M. phaseolina* than *Alternaria brassicicola* and *F. oxysporum*, and growth inhibiton was 36.6% at 25 ppm and 75% at 200 ppm. Besides this silicon compound Ph_3Si (Sal. Anil. TSCZ) also gave good results and growth inhibition was 78.9% at 25 ppm and 86.6% at 50 ppm on *A. brassicicola* on *F. oxysporum* 60% inhibited growth at 25 ppm and 78.9% at 200 ppm. 36.6% at 25 ppm and 64% growth inhibition at 200 ppm was observed on *M. phaseolina* of this compound. Other compounds like Sal. Anil. TSCZ, Ph_3 SnCl, Sal Anil., Ph_3 SiCl, check the growth in decreasing order.

Bactericidal activity (Table 2) of Ph_3Sn (Sal. Anil. TSCZ) was also better than other tested compounds. Diameter of inhibition zone of *X. campestries* was 9 mm on 500 ppm and 18 mm on 2000 ppm concentration. Similar results observed on *Pseudomonas pisi* and 11.5 mm at 500 ppm and 24.0 mm inhibition zone recorded on *E. coli*. 13 mm at 500 ppm and 25 mm at 2000 ppm zone inhibition on *S. aureus*. Starting material Salicylanilide is itself more active and can be used as bactericidal compound. Other compounds Sal. Anil. TSCZ, Ph_3 Si (Sal. Anil TSCZ), Ph_3SnCl, Ph_3SiCl were also inhibited the growth of bacteria in decreasing order. All tested compounds were toxic towards the Gram positive bacteria as compared to Gram negative bacteria.

Acknowledgement

Thanks are due to DST for financial support & Dr. R.V. Singh, Department of Chemistry, University of Rajasthan, Jaipur for providing facilities of fungicides preparation.

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